The Effect of Caffeine Consumption on Sleep Quality among Undergraduate Students in Malaysia

Emmy Hainida Khairul Ikram[1,2*], Nur Afifah Rosli[1], Azizah Mat Hussin[3], Atiyah Nurjannah Chasni[1]

[1]Centre for Dietetics Studies, Faculty of Health Sciences Universiti Teknologi MARA, 42300 Bandar Puncak Alam, Selangor, Malaysia

[2]Integrated Nutrition Sciences and Therapy Research Group (INSPIRE), Faculty of Health Sciences, Universiti Teknologi MARA, Cawangan Selangor Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia

[3]Institute of Medical Science Technology, Universiti Kuala Lumpur, 43000 Kajang, Malaysia

ABSTRACT

This study aims to determine the effect of caffeine consumption on sleep quality among university students. This was a cross-sectional study that used a quantitative approach method. The data for this study was collected using a structured online questionnaire and distributed via online platforms to identify eligible participants. All the participants self-administered all three sections of the questionnaire, which were sociodemographic variables, the caffeine questionnaire tool, and the Pittsburgh Sleep Quality Index (PSQI). A chi-squared test was used to investigate the association between caffeine intake and sleep quality and the measured study characteristics. About 300 students, with a mean age of 21.95±1.43 years old, were recruited. The average caffeine intake of the study population was 193.54 mg per day. The respondents had good sleep quality was 44.7% while 55.3% had poor sleep. The study also found that there was a significant association between caffeine intake and sleep quality (p-value<0.01). Meanwhile, there was no significant association between sociodemographic characteristics and caffeine intake or sleep quality. This study shows that a student's excessive intake of caffeine is correlated with poor sleep quality. Therefore, prevention strategies should be used to raise awareness of the issue and understand how consuming too much caffeine might result in poor sleep quality.

Keywords: caffeine, Malaysia, sleep quality, students

INTRODUCTION

Caffeine is a naturally produced stimulant commonly present in tea, coffee, and cacao plants. It is stated that caffeine works by stimulating the brain and the central nervous system (Watson *et al.* 2016). The same study suggested that caffeine helps individuals in maintaining alertness and reducing the onset of fatigue. Nowadays, the use of caffeine is widespread, particularly among students. A research that was published in the National Library of Medicine found that 79% of college students who consume coffee also use caffeine to remain awake (Mahoney *et al.* 2019). According to the US Food and Drug Administration (FDA), healthy adults should not exceed 400 mg of caffeine per day in terms of recommended daily intake.

According to the Centers for Disease Control and Prevention (CDC 2022), people need to get plenty of sleep because it can have a negative impact on their health. Additionally, university students are included in the more than one-third of American people who habitually lack sleep. Adequate sleep is important for university students since it significantly influences their general health and well-being. To stay focused, enhance concentration, and enhance academic performance, students should get the recommended amount of sleep at night. Centers for Disease Control and Prevention (CDC) recommended that individuals between the ages of 18 and 60 should aim to obtain a minimum of seven hours of sleep per night to enhance their overall health and well-being.

Different studies have been done to determine the effect of caffeine consumption on the quality of sleep. A study conducted by AlSharif *et al.* (2018) found that most college

students had poor sleep quality. This was caused by consuming too many caffeine-containing beverages. Another study by Ngu *et al.* (2017) stated that most pre-clinical medical students in Malaysia have poor sleep quality. In the same study, it was also proven that poor sleep quality was associated with caffeinated beverage intake. However, in another study, it was stated that there was no association between subjective sleep quality and the amount of caffeine consumed, with higher amounts of caffeine consumed related to decreased time in bed (Watson *et al.* 2016).

The general objective of this study is to determine the effects of caffeine consumption on sleep quality among undergraduate students in Malaysia. Meanwhile, the specific objectives are to determine the daily caffeine intake that students usually consume among undergraduate students in Malaysia. Secondly, to assess sleep quality over the past month among undergraduate students in Malaysia. Lastly, to investigate the association between caffeine consumption and sleep quality among undergraduate students in Malaysia. In Malaysia, there has not been much research about the association between caffeine intake and sleep quality. Nowadays, university students tend to consume caffeine in their daily lives to increase wakefulness, overcome fatigue, and enhance cognitive performance. This can have a significant impact on their ability to sleep and their overall performance. Hence, by conducting this study, it can show how caffeine intake is associated with sleep quality.

METHODS

Design, location, and time

This was a cross-sectional study that uses a quantitative approach method. The location of the study was Malaysia. This includes both peninsular Malaysia and east Malaysia. This study was conducted among all undergraduate students in both public and private universities. The participants for this study will be undergraduate university students aged 18–24 years. The study was conducted from July 2022 to July 2023 among university students. The ethics application has been approved by the Faculty Ethics Review Committee (FREC), Universiti Teknologi MARA (UiTM), [reference number: FERC/FSK/MR/2023/0037].

Sampling

The sample size for this study was 300 participants. The sample size was calculated using the RaoSoft sample size calculator with a 95% confidence level, a 5.61% error margin, and a 50% response distribution. A convenience sampling method was used for this study. This sampling method was chosen by using judgment and deliberate effort to pick Malaysian students who meet specific criteria for this study. The inclusion criteria for this study include undergraduate university students aged 18–24 years from all programme, and the participant must be able to understand English as the questionnaire will be in English only. The participation of the participants was completely unpaid and voluntary. Meanwhile, international students and those who did not meet all the criteria for this study were excluded. The consent form and an explanation about the study and procedure were distributed together with the questionnaire.

Data collection

The data for this study was collected through a structured online questionnaire and distributed via online platforms to identify eligible participants. The questionnaire consists of three sections: 1) sociodemographic variables (Lieberman *et al.* 2019) , which include age, gender, ethnicity, year of study, and type of university that the participants are currently staying at; 2) the caffeine questionnaire tool, where the participants will complete the 24-hour recall caffeine questionnaire form (Bühler *et al.* 2013); and 3) the Pittsburgh Sleep Quality Index (PSQI), which was a self-reported questionnaire including 19 items that assessed sleep quality over the preceding month. The participants self-administered all three sections of the questionnaire. The consent form and an explanation about the study and procedure were distributed together in the questionnaire.

Data analysis

The Statistical Package for Social Scientists (SPSS) Version 27 statistical analysis was used to analyse the research findings and data. To provide descriptive results, the mean, standard deviation, frequency, and percentage were used. The continuous variable, age and average caffeine intake were computed as Standard Deviation (SD) and mean. For categorical variables, gender,

ethnicity, year of study, type of university, caffeine intake and sleep quality, frequency and percentages were utilized. Independent t-test was used to determine the association between age and sleep quality while, for the association of age and caffeine intake, One-way ANOVA was used. The association between caffeine intake and sociodemographic variables as well as the association between caffeine intake and sleep quality will be examined using the Chi-square test. A statistical test is considered significant when the p-value is below the threshold of 0.05 ($p<0.05$).

RESULTS AND DISCUSSION

Table 1. shows that the average age of the respondents is 21.95±1.43. In this study, 74.0% of the respondents are female students, while 26.0% are male, respectively. Based on the results, 18.7% of the participants were first-

Table 1. Sociodemographic characteristics of the participants (n=300)

Variables	n (%)
Age (Mean± SD)	21.95±1.43
Gender	
Male	78 (26.0)
Female	222 (74.0)
Ethnicity	
Malay	213 (71.0)
Chinese	37 (12.3)
Indian	19 (6.3)
Bumiputera (Sabah & Sarawak)	29 (9.7)
Others	2 (0.7)
Year of study	
First year	56 (18.7)
Second year	63 (21.0)
Third year	145 (48.3)
Fourth year	36 (12.0)
University	
Public university	227 (75.7)
Private university	73 (24.3)

SD: Standard Deviation

year students, followed by second-year (21.0%), third-year (48.3%), and fourth-year (12.0%). Among all respondents, 75.7% studied at a public university, while the other 24.3% studied at a private university.

Table 2 summarizes that 5.7% of the respondents reported no caffeine intake. In comparison, 80.0% of the respondents reported a tolerable caffeine intake, and the other 14.3% reported an excessive caffeine intake. Additionally, the average caffeine intake among the respondents was 193.54±142.74 mg daily.

A study conducted in Bahrain reported that students' average daily caffeine intake was 268 mg (Jahrami *et al.* 2020). Kharaba *et al.* (2022) found that the average intake of caffeine for the total population of the study was 264 mg per day. In addition, Mahoney *et al.* (2019) found that the average caffeine intake was 159 mg daily in five universities in the United States,

The present study found that most university students (94.3%) consumed caffeine. The results were from students who had caffeine in a tolerable and excessive amount. Lohsoonthorn *et al.* (2013) stated in their study that 58% of students used stimulant beverages. In another study that was conducted at a public university in Malaysia, the mean daily caffeine intake among the students was 67.98% (Isa *et al.* 2021). A study conducted at a private university in Malaysia reported that most students consume caffeine from tea, coffee, soft drinks, and chocolate drinks (Isa *et al.* 2021). Most young adults consume a lot of energy drinks and other stimulants to avoid falling asleep and increase their academic performance (Sanchez *et al.* 2013). It was also reported that students consume caffeinated beverages to increase alertness and concentration during study, polish their memory,

Table 2. Caffeine intake of the participants (n=300)

Variable	n (%)	Mean±SD
Caffeine Intake		193.54±142.74
None	17 (5.7)	
Tolerable	240 (80.0)	
Excessive	43 (14.3)	

SD: Standard Deviation

and improve their mood (Kharaba *et al.* 2022; Peng *et al.* 2020).

Table 3 shows there was no association between sociodemographic variables (age, gender, ethnicity, year of study, type of university) and caffeine intake among undergraduate students in Malaysia. There was no association between gender and caffeine intake. This finding was supported by a study conducted at Zayed University in Dubai, which reported no association between gender and caffeine intake (M Al Ghali *et al.* 2017). Inconsistent with our findings, there was an association found between gender and caffeine intake, as female respondents have a higher average caffeine intake compared to male respondents (Kharaba *et al.* 2022).

A study conducted among the US adult population reported that ethnicity strongly shows an association between ethnicity and caffeine intake (Lieberman *et al.* 2019). However, there is a lack of literature and discussion about the association between ethnicity or race and caffeine intake. In contrast, a study conducted at Florida State University among college students reported that levels of education were associated with caffeine intake. Additionally, it is found that people at higher levels of education usually consume more caffeine than those at lower levels of education (Bertasi *et al.* 2021). Limited studies also look for an association between years of study and caffeine. Additionally, there is a lack of literature about this relationship and a weak line between this association

Table 4 shows the results of the frequency and percentage of sleep quality among the respondents. Sleep quality was categorised into

Table 3. The association between sociodemographic factors and caffeine intake of the participants (n=300)

Variable	Caffeine intake			Total n	X^2 (df)/ F (df)	p
	None n (%)	Tolerable n (%)	Excessive n (%)			
Age[a]	21.65±1.17	21.95±1.44	22.07±1.49	300	2.12 (2)	0.53
(Mean± SD)						
Gender[b]					3.69 (2)	0.16
Male	2 (2.6)	68 (87.2)	8 (10.3)	78		
Female	15 (6.8)	172 (77.5)	35 (15.8)	222		
Ethnicity[b]					4.54 (4)	0.81
Malay	13 (6.1)	169 (79.3)	31 (14.6)	213		
Chinese	3 (8.1)	28 (75.7)	6 (16.2)	37		
Indian	0 (0)	15 (78.9)	4 (21.1)	19		
Bumiputera (Sabah & Sarawak)	1 (3.4)	26 (89.7)	2 (6.9)	29		
Others	0 (0)	2 (100.0)	0 (0)	2		
Year of Study[b]					2.26 (2)	0.89
First year	3 (5.4)	43 (76.8)	10 (17.9)	56		
Second year	3 (4.8)	50 (79.4)	10 (15.9)	63		
Third year	10 (6.9)	116 (80.0)	19 (13.1)	145		
Fourth year	1 (2.8)	31 (86.1)	4 (11.1)	36		
University[b]					0.72 (2)	0.70
Public university	14 (6.2)	182 (80.2)	31 (13.7)	227		
Private university	3 (4.1)	58 (79.5)	12 (16.4)	73		

SD: Standard Deviation; [a]One-Way ANOVA reported is in F (df) *p*-value; [b]Chi-square test reported is in X^2 (df) and *p*-value

Table 4. Sleep quality of the participants (n= 300)

PSQI Score	n (%)
≤5 (Good sleep quality)	134 (44.7)
>5 (Poor sleep quality)	166 (55.3)

PSQI: Pittsburgh Sleep Quality Index

two groups: ≤5, which indicates good sleep quality, and >5, which indicates poor sleep quality. Based on the results, 44.7% respondents had good sleep quality and 55.3% respondents had poor sleep.

In the present study, 55.3% of the respondents showed poor sleep quality. The reasons half of the students had poor sleep quality might be related to their coursework, assignments, and activities at the university (Emmy *et al.* 2023; Ab Hamid *et al.* 2021). The present results were in line with previous studies. In a study in Ethiopia, Lemma *et al.* (2012) reported that more than half of the students (55.8%) had poor sleep quality. The prevalence of poor sleep quality was higher among university students in Saudi Arabia at 80% (AlSharif *et al.* 2018), which is higher than the present study. A study from Thailand reported that 48.1% of the participants had poor sleep quality (Lohsoonthorn *et al.* 2013). Most students consume caffeine to stay awake and result in poor sleep quality (Zhang *et al.* 2022). Many factors contribute to poor sleep quality, such as noise, cigarette smoke, and the quality of the air (Altun *et al.* 2012). Sleeping in a room with exposure to tobacco was the most chosen reason for poor

sleep quality for half the college students (Altun *et al.* 2012).

Sociodemographic variables such as age, gender, ethnicity, year of study, and type of university were found to have no statistical association with sleep quality. According to Mahoney *et al.* (2019), there is no correlation between gender and sleep quality, which is in line with the findings of this study. Even the study's results indicate that male students are likelier than female students to have poor sleep quality. However, there was no association between these two characteristics. However, it was reported female students have poor sleep quality compared to male students in Saudi Arabia (AlSharif *et al.* 2018). Nevertheless, the present study result is at par with a study done in Malaysia, which found no statistical association between ethnicity and sleep quality (Yi *et al.* 2022).

There was no association between the year of study and sleep quality. The reasons might be due to different coursework and academic schedules that eventually lead to the student's daily routine. In line with the current study, a study conducted in Korea reported that grade was not associated with sleep quality among non-smoking students (Choi 2020). However, there was a lack of clarification and discussion about the relationship between the current semester and sleep quality.

Table 5 highlighted that there was a significant association between caffeine intake and sleep quality among undergraduate students in Malaysia (p<0.01). The results of this study are in line with previous studies. A study conducted in Saudi Arabia stated that 476 college students with high caffeine intake had poor sleep quality

Table 5. The association between caffeine intake and sleep quality of the participants using Chi square test (n=300)

Variable	Sleep quality		Total n	X^2 (df)	p
	Good n (%)	Poor n (%)			
Caffeine Intake[b]				25.12 (2)	<0.01[*]
None	15 (88.2)	2 (11.8)	17		
Tolerable	111 (46.3)	129 (53.8)	240		
Excessive	8 (19.2)	35 (81.4)	43		

[b]Chi-square test reported in X^2 (df) and *p*-value; [*]Significant of *p*-value< 0.01

compared to those who did not take any caffeine (AlSharif *et al.* 2018). According to Lemma *et al.* (2012), 75% of the students with high caffeine intake have poor sleep quality compared to students with good sleep quality. Vélez *et al.* (2013) also found that caffeine intake was associated with poor sleep quality, especially for those who consume energy drinks.

O'Callaghan *et al.* (2018) stated that caffeine can improve performance; however, the most known side effect is sleep deprivation. One study found that 400 mg of caffeine taken 0, 3, or 6 hours before bedtime significantly interrupts sleep, and the findings for this study also stated that even at 6 hours, caffeine reduces sleep time by more than an hour (Drake *et al.* 2013). Snel and Lorist (2011) reported in their study that caffeine is one of the stimulants that can produce harmful effects on sleep quality, as it has already proven its effectiveness in counteracting sleepiness. Adenosine increases drowsiness, improves slow wave activity during sleep, and lowers the electroencephalogram (Nehlig 2015), while caffeine, an adenosine-receptor antagonist, primarily affects performance via occupying the adenosine receptor (Van Donghen *et al.* 2001). Additionally, caffeine acts primarily on adenosine A1 and adenosine A2A receptors that are related to the function of the brain and are associated with sleep, arousal, and cognition (Ribeiro & Sebastio 2010). In another study, it is mentioned that the presence of caffeine and its main paraxanthine will trigger a change in the adenosine system and will affect sleep (Reichert *et al.* 2022).

CONCLUSION

In conclusion, this study also demonstrates that the majority of the study population consumes caffeine daily while more than half of university students had poor sleep quality. This study also highlighted that there is an association between caffeine intake and sleep quality among undergraduate students in Malaysia.

Hence, to limit daily caffeine intake among students, individuals and the community need to spread awareness regarding this issue so that they become more aware of the negative health outcomes that will happen to them. In addition, the university also plays an important role in handling this issue, as they can limit the number of vending machines that sell caffeinated beverages to reduce the caffeine intake among university students.

DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

REFERENCES

Ab Hamid MR, Mohd Isamudin M, Buhari SS, Khairul Ikram EH. 2021. Quality, understandability and actionability of online patient education material about hypertension. Nutr Food Sci 51(4):621–632. https://doi.org/10.1108/NFS-04-2020-0155

AlSharif SM, Al-Qathmi MS, Baabdullah WM, Alhrkan TA, Fayoumi YA, Alhejaili F, Wali SO. 2018. The effect of caffeinated beverages on sleep quality in college students. Saudi J Intern Med 8(1):43–48. https://doi.org/10.32790/sjim.2018.8.1.6

Altun I, Cinar N, Dede C. 2012. The contributing factors to poor sleep experiences according to the university students: A cross-sectional study. J Res Med Sci 17(6):557–561.

Bertasi RA, Humeda Y, Bertasi TG, Zins Z, Kimsey J, Pujalte GG. 2021. Caffeine intake and mental health in college students. Cureus 13(4). https://doi.org/10.7759/cureus.14313

Bühler E, Lachenmeier DW, Schlegel K, Winkler G. 2013. Development of a tool to assess the caffeine intake among teenagers and young adults. Ernährungs Umschau 61(4):58–63. https://doi.org/10.4455/eu.2014.011

[CDC] Centers for Disease Control and Prevention. 2022. Sleep for good health. https://www.cdc.gov/sleep/features/

getting-enough-sleep.html [Accessed 19th September 2022]

Choi J. 2020. Motivations influencing caffeine consumption behaviors among college students in Korea: Associations with sleep quality. Nutr 12(4):953. https://doi.org/10.3390/nu12040953

Drake CL, Roehrs T, Shambroom JR, Roth T. 2013. Caffeine effects on sleep taken 0, 3, or 6 hours before going to bed. J Clin Sleep Med 9(11):1195–1200. https://doi.org/10.5664/jcsm.3170

Emmy Hainida KI, Md Jasnin SN, Mohd Syrinaz A, Nadiatul Syima MS. 2023. Dietary habit, physical activity and perceived barriers during movement control order among undergraduate students in Puncak Alam, Selangor. Food Res 7(1):264–270. https://doi.org/10.26656/fr.2017.7(1).660

Isa ZM, Anuar AA, Azmi AD, Selvan ST, Hisham NS, Qing YZ. 2021. Does caffeine intake influence the mental health of medical students? Malays J Public Health Med 21(2):22–28. https://doi.org/10.37268/mjphm/vol.21/no.2/art.626

Jahrami H, Al-Mutarid M, Penson PE, Faris M, Saif Z, Hammad L. 2020. Intake of caffeine and its association with physical and mental health status among university students in Bahrain. Foods 9(4):473. https://doi.org/10.3390/foods9040473

Kharaba Z, Sammani N, Ashour S, Ghemrawi R, Meslamani AZA, Al-Azayzih A, Buabeid M, Alfoteih Y. 2022. Caffeine consumption among various university students in the UAE, exploring the frequencies, different sources and reporting adverse effects and withdrawal symptoms. J Nutr Metab 2022:1–7. https://doi.org/10.1155/2022/5762299

Lemma S, Gelaye B, Berhane Y, Worku S, Williams MA. 2012. Sleep quality and its psychological correlates among university students in Ethiopia: A cross-sectional study. BMC Psychiatry 12:237. https://doi.org/10.1186/1471-244X-12-237

Lieberman HR, Agarwal S, Fulgoni III VL. 2019. Daily patterns of caffeine intake and the association of intake with multiple sociodemographic and lifestyle factors in US adults based on the NHANES 2007–2012 surveys. J Acad Nutr Diet 119(1):106–114. https://doi.org/10.1016/j.jand.2018.08.152

Lohsoonthorn V, Khidir H, Casillas G, Lertmaharit S, Tadesse MG, Pensuksan WC, Rattananupong T, Gelaye B, Williams MA. 2013. Sleep quality and sleep patterns in relation to consumption of energy drinks, caffeinated beverages, and other stimulants among Thai college students. Sleep and Breathing 17(3):1017–1028. https://doi.org/10.1007/s11325-012-0792-1

M Al Ghali, Al Shaibi H, Al Majed H, Haroun D. 2017. Caffeine consumption among Zayed University students in Dubai, United Arab Emirates: A cross-sectional study. Arab J Nutr Exerc 131–141. https://doi.org/10.18502/ajne.v1i3.1230

Mahoney CR, Giles GE, Marriott BP, Judelson DA, Glickman EL, Geiselman PJ, Lieberman HR. 2019. Intake of caffeine from all sources and reasons for use by college students. Clin Nutr 38(2):668–675. https://doi.org/10.1016/j.clnu.2018.04.004

Nehlig A. 2015. Effects of coffee/caffeine on brain health and disease: What should I tell my patients? Pract Neurol 16(2):89–95. https://doi.org/10.1136/practneurol-2015-001162

Ngu ST, Masalamany K, Abd Manan N, Adam SK. 2017. Sleep quality among pre-clinical medical students in Universiti Putra Malaysia and Universiti Malaya, Malaysia. Educ Med J 9(3):23–31. https://doi.org/10.21315/eimj2017.9.3.3

O'Callaghan FV, Muurlink O, Reid N. 2018. Effects of caffeine on sleep quality and daytime functioning. Risk Management and Healthcare Policy 11:263–271. https://doi.org/10.2147/rmhp.s156404

Peng Z, Dai C, Ba Y, Zhang L, Shao Y, Tian J. 2020. Effect of sleep deprivation on the working Memory-Related N2-P3 components of the Event-Related Potential waveform. Front Neurosci 14:469. https://doi.org/10.3389/fnins.2020.00469

Ribeiro JA, Sebastiao AM. 2010. Caffeine and adenosine. J Alzheimer's Dis 20(s1):S3–S15. https://doi.org/10.3233/jad-2010-1379

Reichert CF, Deboer T, Landolt HP. 2022. Adenosine, caffeine, and sleep–wake regulation: State of the science and

perspectives. J Sleep Res 31(4):e13597. https://doi.org/10.1111/jsr.13597

Sanchez SE, Martinez C, Oriol RA, Yanez D, Castañeda BC, Sanchez E, Gelaye B, Williams MA. 2013. Sleep quality, sleep patterns and consumption of energy drinks and other caffeinated beverages among Peruvian college students. Health 5(8B):26–35. https://doi.org/10.4236/health.2013.58a2005

Snel J, Lorist MM. 2011. Effects of caffeine on sleep and cognition. Prog Brain Res 190:105–117. https://doi.org/10.1016/b978-0-444-53817-8.00006-2

Van Donghen HP, Prince NJ, Mullington JM, Szuba MP, Kapoor SC, Dinges DF. 2001. Caffeine eliminates psychomotor vigilance deficits from sleep inertia. Sleep 24(7):813–819. https://doi.org/10.1093/sleep/24.7.813

Vélez JC, Souza A, Traslaviña S, Barbosa C, Wosu A, Andrade A, Frye M, Fitzpatrick AL, Gelaye B, Williams MA. 2013. The epidemiology of sleep quality and consumption of stimulant beverages among Patagonian Chilean college students. Sleep Disord 2013:1–10. https://doi.org/10.1155/2013/910104

Yi, Yi NJ, Ming CZ, Sivam H, Yu Kiat BC, Khobragade S, Kyaw Soe HH, Moe S, Htay MNN. 2022. Association between caffeinated beverages consumption and sleep quality of undergraduate medical students: A cross-sectional study. AJMPCP 5(4):119–127.

Watson EJ, Coates AM, Kohler M, Banks S. 2016. Caffeine consumption and sleep quality in Australian adults. Nutr 8(8):479. https://doi.org/10.3390/nu8080479

Zhang L, Zheng H, Yang M, Zhang Y, Cai G, Li C, Zhao L. 2022. Prediction of sleep quality among university students after analyzing lifestyles, sports habits, and mental health. Front Psychiatry 13:927619. https://doi.org/10.3389/fpsyt.2022.927619